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METABOLISM OF FISSION PRODUCTS—RADIOTELLURIUM

by

L. Jacobson
R. Overstreet
I. Chaikoff, et al.

University of California
Radiation Laboratory

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METABOLISM OF FISSION PRODUCTS—RADIOTELLURIUM

A. PREPARATION OF $Te^{127,129}$ WITHOUT CARRIER

By L. Jacobson and R. Overstreet

OUTLINE OF METHOD

In the foregoing preparation of radiotellurium without carrier, $Te^{127,129}$ is precipitated out of an acid fission mixture in HCl on copper sulfide. This serves to separate the element from all of the principle fission products except zirconium, columbium, and ruthenium. Following this the CuS is decomposed with HNO_3 and the solution is made 5N in HF. The tellurium is then removed from solution on ruthenium sulfide, separating it from zirconium and columbium. The ruthenium sulfide is decomposed with HNO_3 and the residue is boiled with $HClO_4$ to expel the ruthenium.

The $Te^{127,129}$ at this stage is in the hexavalent state. Where hexavalent tellurium is desired, the element is precipitated from the perchloric acid solution on a very small amount of $Fe(OH)_3$ (50 micrograms of Fe). The iron precipitate is dissolved in dilute HNO_3 and the solution is neutralized and used directly.

Where quadrivalent tellurium is desired, the element is removed from the perchloric acid solution on $Fe(OH)_3$. The iron precipitate is dissolved in HCl and the Fe is removed by extraction with isopropyl ether. The $Te^{127,129}$ is then reduced to the metal with hydrazine dihydrochloride and SO_2. The solution is then evaporated to dryness, and the residue is digested with concentrated HNO_3. This serves to decompose the hydrazine and oxidize the tellurium from the metal to the quadrivalent state.

PROCEDURE

The source of the tellurium sample described here was a 1.4M $UO_2(NO_3)_2$ solution which had been prepared by dissolving a uranium slug from the pile in HNO_3. Then, 750 cc of the solution was repeatedly treated with concentrated HCl and boiled to remove the nitrate ion. The nitrate free solution was then diluted to 1000 cc, and 3N in HCl.

Fifty milligrams of $CuCl_2$ was added to the uranium solution, and the solution was saturated with H_2S gas. The mixture was heated to boiling and again saturated with H_2S. The precipitate of CuS was centrifuged out and washed with water. The supernatant liquid and washing were combined and set aside.

The CuS was dissolved in aqua regia. The nitrate was expelled from the resulting solution by repeated evaporations with concentrated HCl. The solution was then diluted to 100 cc. and made 1N in HCl. 50 mg each of barium and strontium and 10 mg each of yttrium, lanthanum, cerium, thorium and cesium were added, and the copper precipitated with H_2S as before. The CuS was centrifuged out, and the supernatant liquid was discarded.

The copper precipitate was decomposed by digestion with a few cc of concentrated HNO_3. The resulting solution was diluted to about 50 cc and made 3N in HNO_3. 10 mg each of yttrium, lanthanum, cerium, thorium, zirconium, columbium, and ruthenium was added. The mixture was then made 5N in HF and the rare earth fluorides centrifuged out. The filtrate was saturated with H_2S gas. The material was digested on the steam bath for 15 minutes and again saturated with H_2S. The ruthenium sulfide precipitate was centrifuged out and washed with 5% NH_2Cl solution and the supernatent liquid and washings were discarded.

The ruthenium sulfide was decomposed by digestion with a few cc of concentrated HNO_3. 5 cc of 70% $HClO_4$ was added and the mixture was boiled until the ruthenium was expelled. 10 mg of ruthenium was added and the solution was again boiled to expel the ruthenium. The solution was then diluted to about 30 cc and treated with 10 mg of Fe. The solution was made alkaline with NH_4OH and heated to boiling. The $Fe(OH)_3$ was centrifuged out and washed with dilute ammonia. The supernatant liquid and washings were discarded.

The iron precipitate was dissolved, 15 cc of 9N HCl, and the Fe was removed from the solution by repeated extractions with equal volumes of isopropyl ether. The iron-free solution was evaporated to a small volume and diluted and made 6N in HCl with a total volume of 12.5 cc. This solution was treated with 1 g of hydrazine dihydrochloride and 12.5 cc SO_2–saturated water. The mixture was boiled for several minutes and then evaporated to dryness.

The residue was digested with concentrated HNO_3 to destroy the hydrazine dihydrochloride. The solution was finally evaporated several times with concentrated HCl to remove the nitrate. The resulting solution contained the radiotellurium in the tellurite (+4) state. The total activity was approximately 120 microcuries as measured with the electroscope.

Hexavalent tellurium was prepared as above, but carried only through the perchloric acid distillation. 50 μg of iron was added to the perchloric acid residue, and the solution made basic with HN_4OH. The resulting $Fe(OH)_3$ precipitate was centrifuged, washed, and taken up in a small amount of nitric acid. Upon assaying, the sample was found to contain 75% telluric tellurium and 25% tellurous tellurium.

CHEMICAL TEST

To a suitable aliquot of the $Te^{127,129}$ solution, 10 mg each of tellurium, Ru, Sr, Ba, Y, La, Ce, Th, Cs, Mo, Rh, Sn and Sb were added. The solution was made 3N in HCl, heated to boiling, and saturated with SO_2. The resulting tellurium metal was centrifuged and washed. The filtrate and washings were combined and boiled to remove SO_2. 10 mg more of tellurium was added to the solution and tellurium metal again precipitated as before. The filtrate and washings from the second tellurium precipitation were evaporated to dryness and measured. 4% of the total activity was found in this fraction, giving a minimum value of 96% for the purity of the $Te^{127,129}$.

B. TRACER STUDIES WITH $Te^{127,129}$

By I. Chaikoff and Associates

The tracer studies of radioactive tellurium were divided into two parts: (1) an investigation of the tetravalent form, and (2) an investigation of the hexavalent form. The same radioactive isotope was employed in both cases.

TETRAVALENT TELLURIUM

This study was carried out on 36 rats weighing between 200 and 300 g. Three modes of administration of the radioactive material were used: oral, intramuscular, and lung. The intramuscular injections (0.4–1.0 cc) were carried out via the thigh muscles of the left leg. The lung administrations (0.2–0.25 cc) were carried out by means of a lung cannula. The oral administrations (0.4–1.0 cc) were carried out by means of a stomach tube. Animals were sacrificed at intervals of 1, 4, 16, and 32 days after injection. There were 9 rats for each interval, 3 for each mode of injection. The injected doses were approximately 5000-6000 counts per second for the oral and intramuscular administrations and approximately 3000 counts per second for the lung administration.

The rats were placed in metabolism cages, and daily excretions of urine and feces were collected separately. The daily collection of urine and feces was facilitated by transferring the animals to clean cages every day. The old cage was washed down thoroughly with hot water after each transfer, and the washings were added to the urine. The orally and intramuscularly injected animals were placed in separate cages for the first 4 or 5 days after injection so that the excretions could be measured for each animal individually during this interval when the excreta were very active. After the fourth or fifth day the 3 animals in each group were combined in one cage and feces and urine collected in common from each group. A simple device was used to collect urine and feces separately in all cases. The three rats in each group of lung-administered animals were combined in one cage immediately after injection, no individual collection of excreta being made in this case. The rats were fed the regular stock diet and tap water ad libitum.

Sampling of Tissues

At the time of sacrifice each rat was anesthetized with nembutal and blood withdrawn by heart puncture. The blood was delivered into a weighed, porcelain, milk ashing dish, and the weight of the blood sample was obtained by difference. The animal was first skinned, then the following tissues were removed and weighed: liver, 2 kidneys, spleen, lungs, heart, brain, mesenteric lymph nodes, bone (2 femurs, 2 tibias, and 2 fibulas), tail fat, mesenteric fat, a sample of gastrocnemius muscle, 2 testes, 2 teeth (incisors), gastrointestinal tract (from the cardiac sphincter to the rectum), 2 thyroids and 2 adrenals. All of the tissues, were transferred directly to weighed, numbered, milk ashing dishes, except in the following instances:

1. Kidney — In cases where a single kidney was too active to count on our counter (for example, at an early interval after intramuscular injection) the 2 kidneys were minced well in a beaker with the aid of scissors, and 2 aliquots of the kidney mince were weighed out into previously weighed milk ashing dishes. In some cases each single kidney was placed in a milk ashing dish. When the activity was not high, both kidneys were placed together in a small beaker for ashing as described below.
2. Liver — In cases where the liver was too active to be counted in its entirety, it was first well minced with scissors and 2 aliquots weighed out into milk ashing dishes. When the entire liver could be counted, it was placed in a beaker for ashing.
3. Gastrointestinal Tract — After removal from the animal, the gastrointestinal tract was washed by forcing water through the lumen. The contents and washings were added to the feces collection of the last day. The tissue was then rinsed in tap water, blotted on a paper towel, weighed, and transferred to a beaker for ashing.
4. Muscle — The muscle sample was usually too large to be treated in a milk dish, and therefore it was transferred to a beaker for ashing.
5. Skin and Hair — After weighing, the skin and hair sample was transferred to a large beaker for ashing.
6. Carcass — The carcass remaining after removal of all tissues was weighed and then thoroughly ground in a meat grinder. The resulting mince was reasonably homogeneous, and 2 aliquots were weighed and transferred to beakers for ashing.
7. Left leg of intramuscularly-injected animals (site of injection) — The entire left leg minus the foot was weighed and transferred to a beaker for ashing. Bone and muscle samples were then taken only from the right leg in intramuscularly-injected animals.
8. Lungs of lung-injected animals — Since the lungs might be expected to be very active in these animals, the lungs were transferred to beakers for ashing, and an aliquot of the solution of ash taken for counting.
9. Blood — When the blood was quite active, the samples taken for counting were small enough to be treated in milk ashing dishes. For the later intervals, however, the sample of blood taken for counting was too large to be treated in a milk ashing dish, and it was delivered into a weighed beaker for ashing. Blood samples were usually taken in duplicate.
10. Feces and Urine — Feces and urine were collected in beakers and were ashed directly in the beakers in which they were collected.

Ashing Procedure

Experiment showed that some radioactivity was lost by ashing at temperatures as low as 300°, even after previous treatment with HNO_3. For this reason a wet ashing procedure was adopted. The tissues were treated with concentrated HNO_3 on the steam bath. The smaller tissues were ashed directly in the milk ashing vessels. The larger tissues were ashed in beakers, and the resulting ash was either transferred wholly to a milk ashing dish or made up to volume and an aliquot delivered into a milk ashing dish. Since all of the milk ashing dishes had previously been numbered and weighed, the weight of the ash remaining after the HNO_3 treatment could be obtained simply by weighing the vessel plus the ash and subtracting the weight of the vessel. The correction to be applied for a given weight of ash was obtained from the mass absorption curve.

Mass Absorption Curve

Carcass ash was prepared by ashing several rats in the muffle at 500°. A saturated solution of this carcass ash in HCl was prepared and varying amounts of this solution (0.9 cc) were added to a series of 10 cc volumetric flasks containing the same amount of radioactive tellurium. Aliquots of the resulting solutions were pipetted into weighed milk ashing dishes, and the samples were dried on the steam bath. After drying, the weight of the ash was obtained, and the samples were counted. The counts were compared with the theoretical counts to be expected if no ash solution had been added.

This procedure was carried out twice, and the mass absorption curve (Figure 1) was drawn up, plotting mg of ash against correction factor. The correction factor was that factor by which the observed number of counts had to be multiplied in order to give the number of counts which would have been obtained with no mass present. The best curve through the experimental points was a straight line. The correction factor for various weights of ash was as follows (from the absorption curve):

Ash St. (mg)	Factor
225	1.00
750	1.22
1200	1.42
1800	1.67
2400	1.92
3000	2.18
3600	2.43

Calculations

The background of the counter and tube used throughout most of this investigation was about 1.2 counts per second. On the bases of variations in the background over a long period of time, a figure of 0.2 counts per second was arbitrarily taken as the maximum error of the background count, and samples which contained an activity equal to background were calculated as $<.2$ counts per second. Samples containing between 0 and 0.4 counts per second (after subtracting background) were assumed to have a maximum possible error of 100% and thus they were calculated as containing $<$ twice the observed count. In this way an upper limit was set for the recovery in weak samples. For samples containing between 0.5 and 1 counts per second, only one significant figure was retained for the final recovery.

HEXAVALENT TELLURIUM

This study was carried out on 9 rats. Only oral and intramuscular routes of administration were employed. The time intervals were as follows: 4-day oral (3 rats), 4-day intramuscular (3 rats), and 16-day intramuscular (3 rats). The injected dose was 1.0 cc containing about 1600 counts per second.

This procedure for this study was exactly the same as that described above for tetravalent tellurium.

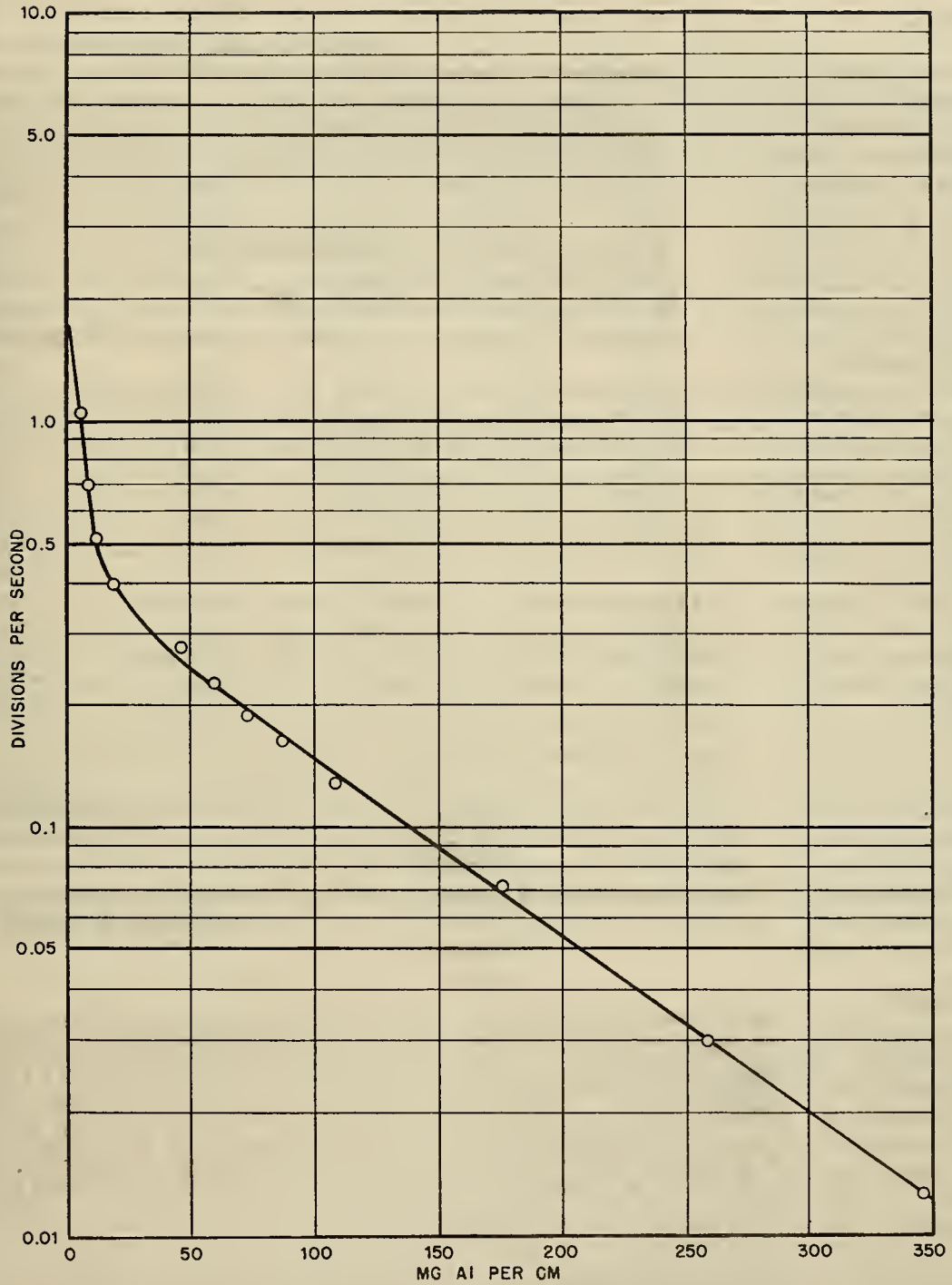

Figure 1. Al absorption curve for $Te^{127,129}$.

RESULTS

The results of the o… ramuscular experiments using tellurous tellurium (+4) are in Tables 1-4 inclusive and the co… g experiments with telluric tellurium (+6) are indicated in Tables 5-6. The oral studies re… t approximately 25% of the administered dose of the +4 tellurium was absorbed by way of the … ract. The distribution of the absorbed activity indicated that the tellurium was deposited pr… in the blood, liver, and kidney. Following intramuscular administration, the distribution … sorbed activity followed essentially the same pattern as was noted in the oral studies. The ra… mination of the absorbed tellurium following both routes of administration were surprisingl… and a considerable proportion of the tellurium was eliminated during the first day by way of t… y. Thereafter the rate of urinary elimination fell sharply and became equal to the daily excret… ay of the digestive tract. Approximately three fourths of the absorbed dose in both oral and int… ular studies was excreted during the 3½-day interval of the experiments with +4 tellurium.

The lungs studies w… ite unsatisfactory from the point of view of reasonably quantitative data, due to the fact that such… siderable proportion of the administered tellurium that is invariably swallowed by the anima… use of the technique employed was absorbed from the digestive tract. This tended to obscure t… erpretation as to what proportion of the activity in the tissue was from tellurium absorbed by v… the digestive tract and what proportion was absorbed through the lungs. However, it was very … t from the lung experiment that the amount of pulmonary retention of +4 tellurium in the lungs … latively small, probably less than 5% of the quantity originally introduced into the lungs.

Time did not per… ore extensive studies with telluric tellurium and, of course, the interpretation of the data pre… is somewhat impaired because of the fact that approximately 25% of the tellurium present in t… avalent preparation was in the form of tellurous tellurium. No major qualitative differences… istribution of the hexavalent tellurium were noted following intramuscular administration, excep… the fact that a significantly higher proportion of the administered dose remained unabsorbed a… site of injection. It is also apparent that at the 4-day interval the oral absorption of hexavalen… urium was significantly less than was noted at the corresponding time interval for +4 tellurium. In… of the fact that the apparent oral absorption in the +6 state was approximately one-half of that with … 4 tellurium while the material used in the +6 form contained 25% of the +4 tellurium, it seems … reasonable to conclude that a considerable proportion of the +6 tellurium may have been reduced to … tellurium during its sojourn in the digestive tract. The rates of elimination of the absorbed telluriu… n the +6 experiments, following both oral and intramuscular administration, was approximately t… same and also was comparable to the corresponding experiments in which +4 tellurium was emplo… l.

DISCUSSION

The principle po… its of interest arising from the results of the experiments just described are: first, tellurium, whe… ier administered either in the tellurous or telluric state, is absorbed by way of the digestive tract. … seems quite possible that in these experiments the +6 tellurium was not as readily taken up by way of t… e digestive tract, and that its assimilation takes place by its first being converted to tellurous telluriu… n, which is then absorbed; second, the rates of elimination of absorbed tellurium in both valence states and by both oral and intramuscular administration are rapid and essentially comparable. The rates of excretion during the time intervals studied indicate an approximate one-half time of retention in the body of 16 days. This is substantially less than the one-half periods of the radioactive decay of Te^{127} and Te^{129} which are 32 and 90 days respectively. This observation places tellurium in the small list o… the long-life fission products whose rates of elimination are greater than their rates of radioactive de… y. The other members of this group are ruthenium, xenon, and cesium. Third, the principle organs of deposition for absorbed tellurium are blood, liver, and kidney. On the per gram basis the kidney tissue is from 2 to 5 times more active than any other of the tissues. In all of the intramuscular studies with tellurous and telluric tellurium the blood was more active per gram than the

Table 1. Recovery of tetravalent radiotellurium in the tissues of the rat one day after oral or intramuscular administration (avg. of 3 rats).

Tissue	Oral Administration Per Cent Recovery			Intramuscular Administration Per Cent Recovery		
	Per Gram	Per Organ	In Sample	Per Gram	Per Organ	In Sample
Blood	0.27	4.7	0.44	0.32	5.6	0.19
Liver	0.54	4.8	4.8	0.30	2.4	2.4
Kidneys	0.52	0.87	0.87	1.5	2.4	2.4
Spleen	0.15	0.10	0.10	0.30	0.30	0.30
G.I. Tract	0.10	1.2	1.2	0.081	0.90	0.90
M. Lymph Nodes	0.07	---	0.01	0.11	---	0.068
Lungs	0.090	0.095	0.095	0.14	0.21	0.21
Brain	0.012	0.021	0.021	0.014	0.025	0.025
Muscle	0.013	1.4	0.095	0.025	2.5	0.15
Heart	0.050	0.39	0.039	0.093	0.070	0.070
Bone	0.055	0.74	0.089	0.22	4.2	0.26
Teeth	.05	---	.006	0.07	---	0.01
Left Leg	---	---	---	4.5	54.2	54.2
Thyroid	.4	.01	.01	.4	.01	.01
Adrenals	.4	.01	.01	.4	.01	.01
Testes	0.019	0.049	0.049	0.052	0.12	0.12
M. Fat	0.023	---	0.046	0.035	---	0.043
Tail Fat	.01	---	.014	0.02	---	0.02
Skin & Hair	0.013	0.64	0.64	0.041	1.9	1.9
Carcass	0.022	2.6	2.6	0.071	7.6	7.6
Excreta						
Feces			68.6			2.9
Urine			13.1			24.4
			81.7			27.3
Recovery in Tissues			11.5			71.0
Recovery in Excreta			81.7			27.3
Total Recovery in Animal			93.2			98.3

Table 2. Recovery of tetravalent radiotellurium in the tissues of the rat 4 days after oral or intramuscular administration (avg. of 3 rats).

Tissue	Oral Administration Per Cent Recovery			Intramuscular Administration Per Cent Recovery		
	Per Gram	Per Organ	In Sample	Per Gram	Per Organ	In Sample
Blood	0.23	4.4	0.54	0.82	16.0	0.86
Liver	0.15	1.3	1.3	0.52	4.8	4.8
Kidneys	0.53	0.98	0.98	3.3	6.0	6.0
Spleen	0.14	0.14	0.14	0.60	0.94	0.94
G. I. Tract	0.035	0.39	0.39	0.16	1.7	1.7
M. Lymph Nodes	0.048	---	0.019	0.27	---	0.11
Lungs	0.061	0.075	0.075	0.32	0.41	0.41
Brain	0.01	0.02	0.02	0.025	0.042	0.042
Muscle	0.013	1.5	0.18	0.070	7.8	0.51
Heart	0.045	0.036	0.036	0.20	0.14	0.14
Bone	0.055	0.87	0.11	0.37	5.4	0.34
Teeth	.06	---	.007	0.15	---	0.02
Thyroid	.4	.009	.009	.5	.013	.013
Adrenals	.2	.004	.004	.6	.02	.02
Testes	0.012	0.031	0.031	0.085	0.25	0.25
M. Fat	0.01	---	0.03	0.11	---	0.17
Tail Fat	.004	---	.007	0.04	---	0.05
Skin & Hair	0.015	0.85	0.85	0.086	4.5	4.5
Carcass	0.029	3.7	3.7	0.15	18.5	18.5
L. Leg				2.0	21.6	21.6

Excreta	Day	Urine	Feces	Urine	Feces
	1	7.4	61.6	16.2	2.1
	2	2.13	8.5	2.9	3.8
	3	3.1	1.14	3.3	2.9
	4	0.89	0.71	2.6	3.2
		13.5	72.0	25.1	12.0
Recovery in Tissues		8.9		61.8	
Recovery in Excreta		85.5		37.1	
Total Recovery in Animal		94.4		98.9	

Table 3. Recovery of tetravalent radiotellurium in the tissues of the rat 16 days after oral or intramuscular administration.

Tissue	Oral Administration Per Cent Recovery			Intramuscular Administration Per Cent Recovery		
	Per Gram	Per Organ	In Sample	Per Gram	Per Organ	In Sample
Blood	0.12	2.4	0.35	0.57	10.5	1.2
Liver	0.036	0.27	0.27	0.20	1.2	1.2
Kidneys	0.18	0.30	0.30	1.3	2.1	2.1
Spleen	0.094	0.12	0.12	0.41	0.29	0.29
G. I. Tract	0.011	0.11	0.11	0.081	0.70	0.70
M. Lymph Nodes	.05	---	.01	0.1	---	0.02
Lungs	0.028	0.030	0.030	0.15	0.16	0.16
Brain	.01	.02	.02	0.028	0.046	0.046
Muscle	0.011	1.2	0.055	0.082	0.4	0.67
Heart	0.02	0.015	0.015	0.14	0.11	0.11
Bone	0.025	0.36	0.048	0.30	4.1	0.28
Teeth	.06	---	.007	0.22	---	0.036
L. Leg	---	---	---	0.70	8.1	8.1
Thyroid	.3	.007	.007	.4	.009	.009
Adrenals	.2	.006	.006	.3	.006	.006
Testes	0.008	0.2	0.02	0.045	0.13	0.13
M. Fat	.007	---	.01	0.069	---	0.15
Tail Fat	.006	---	.006	0.03	---	0.05
Skin & Hair	0.0051	0.28	0.28	0.051	2.6	2.6
Carcass	0.011	1.5	1.5	0.11	11.7	11.7

Excreta	Day	Urine	Feces	Urine	Feces
	1	5.6	63.7	15.3	2.4
	2	1.7	6.0	3.3	3.6
	3	1.3	0.81	3.1	2.8
	4	0.80	0.28	2.4	1.7
	5	0.60	0.29	2.0	1.7
	6	0.35	0.25	1.6	1.1
	7	0.21	0.27	1.8	0.93
	8	0.16	0.17	1.5	1.3
	9	0.16	0.13	1.2	0.75
	10	0.24	0.12	1.3	0.57
	11	0.17	0.14	1.1	0.93
	12	0.17	0.084	0.62	0.67
	13	0.14	0.081	0.95	0.57
	14	0.12	0.11	0.80	0.50
	15	0.090	0.078	0.85	0.47
	16	0.12	0.22	0.83	0.87
		11.9	72.7	38.7	20.9
Recovery in Tissue		3.5		30.8	
Recovery in Excreta		84.6		59.6	
Total Recovery in Animal		88.1		90.4	

Table 4. Recovery of tetravalent radiotellurium in the tissues of the rat 32 days after oral or intramuscular administration (avg. of 3 rats).

Tissue	Oral Administration Per Cent Recovery			Intramuscular Administration Per Cent Recovery		
	Per Gram	Per Organ	In Sample	Per Gram	Per Organ	In Sample
Blood	0.018	0.38	0.092	0.21	3.9	0.67
Liver	0.0056	0.056	0.056	0.10	0.72	0.72
Kidneys	0.033	0.070	0.070	0.51	0.86	0.86
Spleen	.03	.03	.03	0.19	0.20	0.20
G. I. Tract	.003	.03	.03	0.036	0.40	0.40
M. Lymph Nodes	.04	---	.006	.06	---	.014
Lungs	.02	.02	.02	0.065	0.072	0.072
Brain	.004	.006	.006	0.02	0.03	0.03
Muscle	0.003	0.4	0.04	0.035	3.6	0.26
Heart	.03	.03	.03	0.04	0.03	0.03
Bone	0.01	0.2	0.02	0.16	2.4	0.14
Teeth	.08	---	.01	0.1	---	0.02
Thyroid	.3	.006	.006	.3	.006	.006
Adrenals	.3	.006	.006	.3	.007	.007
Testes	.005	.01	.01	0.026	0.064	0.064
M. Fat	.009	---	.02	.03	---	.02
Tail Fat	.006	---	.006	.01	---	.006
Skin & Hair	0.001	0.08	0.08	0.020	1.0	1.0
Carcass	0.003	0.5	0.5	0.056	6.6	6.6
L. Leg				0.50	6.5	6.5

Excreta (Table 4).

Day	Oral Adm. % Recovery Urine	Feces	Intramuscular Adm. % Recovery Urine	Feces	Day	Oral Adm. % Recovery Urine	Feces	Intramuscular Adm. % Recovery Urine	Feces
1	10.5	67.9	1.5	21.9	20	0.059	0.065	0.50	0.75
2	2.9	3.9	1.2	1.7	21	0.054	0.72	0.74	0.82
3	0.90	0.50	1.2	1.5	22	0.045	0.17	0.45	0.77
4	0.31	0.25	0.93	1.3	23	0.059	0.04	0.59	0.71
5	0.31	0.35	0.88	1.5	24	0.055	0.01	0.40	0.60
6	0.31	0.18	0.79	1.3	25	0.036	0.008	0.47	0.57
7	0.12	0.24	0.77	1.4	26	0.025	0.05	0.48	0.61
8	0.27	0.12	0.75	1.0	27	0.030	0.02	0.31	0.41
9	0.19	0.12	0.83	1.1	28	0.079	0.02	0.34	0.48
10	0.13	0.095	0.90	1.0	29	0.019	0.03	0.31	0.48
11	0.14	0.055	0.80	1.0	30	0.046	0.009	0.23	0.48
12	0.11	0.59	0.79	1.0	31	0.026	0.01	0.33	0.37
13	0.083	0.05	0.79	1.0	32	0.035	0.05	0.56	.41
14	0.20	0.17	0.66	1.1		18.0	76.5	22.0	49.9
15	0.097	0.094	0.81	1.0	Recovery				
16	0.13	0.17	0.72	1.0	in Tissues	0.9		18.2	
17	0.088	0.24	0.70	0.89	in Excreta	94.5		71.9	
18	0.097	0.05	0.68	0.94	Total	95.4		90.1	
19	0.060	0.17	0.60	0.79					

Table 5. The recovery of hexavalent radiotellurium in the tissues of the rat 4 days after oral or intramuscular administration (avg. of 3 rats)

Tissue	Oral Administration Per Cent Recovery			Intramuscular Administration Per Cent Recovery		
	Per Gram	Per Organ	In Sample	Per Gram	Per Organ	In Sample
Blood	0.077	1.3	0.28	0.29	4.6	0.80
Liver	0.092	0.90	0.90	0.14	1.0	1.0
Kidneys	0.17	0.33	0.33	0.80	1.4	1.4
Spleen	0.055	0.084	0.084	0.24	0.26	0.26
G. I. Tract	0.014	0.16	0.16	0.043	0.39	0.39
M. Lymph Nodes	.05	---	.013	.1	---	.03
Lungs	.04	.05	.05	0.084	0.084	0.084
Brain	.007	.013	.013	.02	.03	.03
Muscle	.005	0.5	0.05	0.020	1.6	0.084
Heart	.04	.03	.03	0.06	0.04	0.04
Bone	.03	0.5	0.05	0.32	3.8	0.28
Teeth	.09	---	.013	.2	---	.02
L. Leg	---	---	---	3.8	35.2	35.2
Thyroid	.5	.013	.013	.5	.013	.013
Adrenals	.5	.013	.013	.5	.013	.013
Testes	.01	.02	.02	0.03	0.07	0.07
M. Fat	.02	---	.03	.04	---	.05
Tail Fat	.03	---	.013	0.05	---	0.03
Skin & Hair	0.005	0.2	0.2	0.032	1.2	1.2
Carcass	0.013	1.3	1.3	0.068	6.5	6.5

Excreta	Day	Feces	Urine	Urine	Feces
	1	59.0	13.3	22.4	3.0
	2	2.6	4.7	3.5	0.73
	3	0.25	1.3	2.3	0.51
	4	0.17	0.79	1.8	0.80
		62.0	20.1	30.0	5.0
Recovery in Tissues			3.6		47.5
Recovery in Excreta			82.1		35.0
Total Recovery in Animal			85.7		82.5

Table 6. Recovery of hexavalent radiotellurium in the tissues of the rat 16 days after intramuscular administration (avg. of 3 rats).

Tissue	Per Cent Recovery		
	Per Gram	Per Organ	In Sample
Blood	0.37	6.6	1.3
Liver	0.12	1.1	1.1
Kidneys	0.80	1.3	0.3
Spleen	0.20	0.16	0.16
G. I. Tract	0.046	0.56	0.56
M. Lymph Nodes	.2	---	.02
Lungs	0.11	0.13	0.13
Brain	0.02	0.04	0.04
Muscle	0.043	4.4	0.21
Heart	0.1	0.08	0.08
Bone	0.27	3.7	0.25
Teeth	.3	---	.04
L. Leg	1.3	14.9	14.9
Thyroid	.6	.02	.02
Adrenals	.6	.02	.02
Testes	0.05	0.1	0.1
M. Fat	0.04	0.04	0.04
Tail Fat	.03	---	.03
Skin & Hair	0.031	1.2	1.2
Carcass	0.074	8.1	8.1

Excreta	Day	Feces	Urine
	1	4.2	20.4
	2	0.92	3.0
	3	0.75	2.1
	4	0.62	1.5
	5	0.36	1.1
	6	0.47	1.1
	7	0.72	0.90
	8	0.67	1.0
	9	0.57	1.0
	10	0.59	1.1
	11	0.63	0.96
	12	0.55	0.93
	13	0.48	0.95
	14	0.58	0.81
	15	0.55	0.65
	16	0.73	0.61
		13.4	38.1

Recovery in Tissues	29.5
Recovery in Excreta	51.5
Total Recovery in Animal	81.0

liver. The blood showed the highest per organ content of tellurium, and it is of interest to note that these relative levels were maintained even up to the 32-day interval.

The small but constant retention of activity in the skeleton, which showed no significant change throughout the entire 32-day interval, together with the fact that the relative proportion of activity in the skeleton as compared to other tissues was somewhat lower in the oral experiments as compared to the corresponding intramuscular experiments, suggests that there may have been from 2 to 5% of radioactive impurities in the tellurium preparations employed, such as alkaline earths, rare earths, zirconium, and columbium. It does not appear that the tellurium shows any significant tendency to either deposition or retention by the skeleton.

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